themselves. If, for example, we let the cathode rays fall on a plate, one-half consisting of a 0.3 mm. sheet of platinum and the other half of a 1 mm. sheet of aluminum, a pin-hole photograph of this double plate will show that the sheet of platinum emits a far greater number of X-rays than does the aluminum sheet, this remark applying in either case to the side upon which the cathode rays impinge. From the reverse side of the platinum, however, practically no X-rays are emitted, but from the reverse side of the aluminum a relatively large number are radiated. It is easy to construct an explanation of this observation; still it is to be recommended that before so doing we should learn a little more about the characteristics of X-rays.

It must be mentioned, however, that this fact has a practical bearing. Judging by my experience up to now, platinum is the best for generating the most powerful X-rays. I used a few weeks ago, with excellent results, a discharge apparatus in which a concave mirror of aluminum acted as cathode and a sheet of platinum as anode, the platinum being at an angle of 45 deg. to the axis of the mirror and at the center of curvature.

§ 21. The X-rays in this apparatus start from the anode. I conclude from experiments with variously-shaped apparatus that as regards the intensity of the X-rays it is a matter of indifference whether or not the spot at which these rays are generated be the anode. With a special view to researches with alternate currents from a Tesla transformer, a discharge apparatus is being made in which both electrodes are concave aluminum mirrors, their axes being at right angles; at the common center of curvature there is a 'cathode-ray catching' sheet of platinum. As to the utility of this apparatus I will report further at a later date.

W. K. RÖNTGEN.

BEHAVIOR OF SUGAR TOWARDS RÖNTGEN RAYS.

THE fact that sugar is transparent to X-rays was ascertained at an early date after Röntgen's announcement of his momentous discovery. It seemed, however, of interest to learn whether the structure of the sugar traversed by the rays might exercise any influence on the rays or modify their action on photographic plates.

Through the courtesy of Prof. M. I. Pupin, of Columbia University, who kindly extended the privileges of his laboratory to the writer, the following tests were made:

Two plates of sugar were selected. The one was a disk 16 mm. thick, sawed from a titlar; a titlar is made by pouring a magma of best white refined sugar into a cone-shaped mould, washing well with pure white sugar liquor, and then baking the mass perfectly dry and hard. This disk was, therefore, practically a solid agglomeration of pure sucrose crystals. The other disk was made by dissolving perfectly pure white sugar in water, evaporating to a certain consistency, and then casting the mass in a copper ring. This disk also measured 16 mm. in thickness; it was a perfectly clear and transparent solid of a yellow color, and consisted of amorphous sugar-candy—so-called barley sugar.

A few preliminary trials were made by photographing with X-rays through these plates of sugar—with and without fluorescent screens—varying the time of exposure, etc. Finally, the following experiment was carried out.

A photographic plate was placed in a box, on the outside of which six metal disks were arranged in two groups of three each. Each group consisted of a medal of aluminium, provided with figures and inscriptions in bas-relief, a plain disk of aluminium and a silver quarter dollar.

One of these groups was covered with the crystalline, the other with the amorphous

sugar plate. The Crookes tube was suspended $6\frac{1}{4}$ inches above the plates and an exposure of forty minutes was given.

The conditions under which the two sugar plates were placed were therefore identical and the results obtained comparable. On developing the photographic plate it was found that both sugar plates had permitted the X-rays to pass through sufficiently freely to form clear and well defined pictures of the metallic disks.

The figures and inscriptions on the aluminium medals were discernible in both instances, and the outlines of both the aluminium disks and of the silver coins were also well marked.

The negative, however, showed unmistakably that the amorphous sugar is more transparent to the X-rays than the crystalline modification. In the former case the background proved to have an even and darker hue, showing that X-rays had passed through freely and evenly. In the latter case the background was less dark and of a rather mottled appearance, in some places exhibiting apparently a faint outline tracing of the crystalline structure beneath which it had rested. This fact may be of interest in view of the mooted question concerning the power of diffusion and refraction of the X-rays.

In this connection it may not be amiss to also refer, briefly, to some tests made to ascertain whether or no the X-rays exercise any influence on polarized light. To this end a tube was made of aluminium, 200 mm. in length and 31 mm. in diameter; the walls were 2 mm. thick. This tube was filled successively with solutions of sucrose, dextrose, levulose and raffinose.

This tube with its contents was placed in a sugar polariscope ; a ray of light was permitted to pass through the tube and the deviation of the polarized light produced by the solutions was noted. The polariscope with the filled tube was then placed underneath a Crookes tube in such a manner that the tube was directly in the path of maximum intensity of the X-rays, *i. e.*, in the path of the cathode rays, so that the rays would pass through the tube practically at right angles to the beam of polarized light which traversed the tube longitudinally.

The times of exposure given varied; seven minutes for the sucrose solution, ten minutes for the levulose and the raffinose solution and fifteen minutes for the dextrose solution, but in no instance was any deviation of the ray of polarized light noticeable. The polarization of the solutions were :

Sucrose, ...	+49.9
Raffinose, ...	+15.3
Dextrose, ...	+ 7.2
Levulose, ...	— 8.8

Of course these tests alone are not sufficient in number or kind to permit the drawing of any conclusive inference as to whether the X-rays influence the plane of polarized light or not, but they do establish the fact that, under the conditions under which these tests were made, no such influence was exerted. FERDINAND G. WIECHMANN.

THE X-RAYS IN MEDICINE AND SURGERY.

ON April 22d I succeeded in applying the X-rays to the diagnosis of disease in such a manner as to make it seem that a very wide field was open to medical as well as to surgical investigations by means of the X-ray.

Using a 'focussing' tube powerfully driven, I found it quite possible to cause calcium tungstate to fluoresce, even though a human trunk or head be interposed between the tube and the fluorescing screen.

Further, it became evident that the backbone, the ribs, the bones of the members, and the outline of the skull and of the upper portion, at least, of the pelvis could be